REPORT No. 266

AIR FORCE AND MOMENT FOR N-20 WING WITH CERTAIN CUT-OUTS

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INTRODUCTION

The airplane designer often finds it necessary, in meeting the requirements of visibility, to remove area or to otherwise locally distort the plan or section of an airplane wing. This report, prepared for the Bureau of Aeronautics January 15, 1925, and submitted for publication to the National Advisory Committee for Aeronautics November 29, 1926, contains the experimental results of tests on six 5 by 30 inch N-20 wing models, cut out or distorted in different ways, which were conducted in the 8 by 8 foot wind tunnel of the Navy Aerodynamical Laboratory in Washington in 1924.

The measured and derived results are given without correction for Vl/ν or for wall effect and for standard air density, $\rho=0.00237$ slug per cubic foot.

DESCRIPTION OF MODELS

The principal dimensions and specified offsets of the six models are given in Figure 1; their full-scale section views in Figure 4. They were made of dry mahogany and varnished, then satisfactorily verified by application of their steel templates. The two wings, composing model N-20_A, were assembled by means of two streamlined steel members in the position of the spars. The other models were made completely of wood.

RESULTS

Tables I to XIII give the numerical results of the tests, all of which were made at 40 miles per hour; the first three containing test data, the next four the lift and drag coefficients, and the next six the speed and power factors, efficiencies, and center of pressure coefficients. The data, excepting for K_x and K_y coefficients, are plotted in Figures 2, 3, and 4. Table XIV gives the chief structural and aerodynamic characteristics of the models.

While no analysis of the results is attempted, a few conclusions are outstanding. Although the N-20 wing with no cut-out or distortion has the largest values of L/D maximum, C_L maximum and maximum speed ratio, some of the distorted forms outperform it in other items. The N-20_C, for instance, has the lowest minimum C_D; the largest L/D at $\frac{1}{8}$ C_L maximum and the largest C_L maximum/C_D minimum. Likewise N-20_E is the best of the six for minimum power and maximum ceiling, and N-20_D is best for effectiveness in climbing. On the other hand the performance of N-20_B, and particularly N-20_A, is less favorable in every item.

REFERENCE

Powell, C. H.: On the Effects of Cutting a Hole in the Top Plane of a Biplane. British Reports and Memoranda No. 419. 1918.

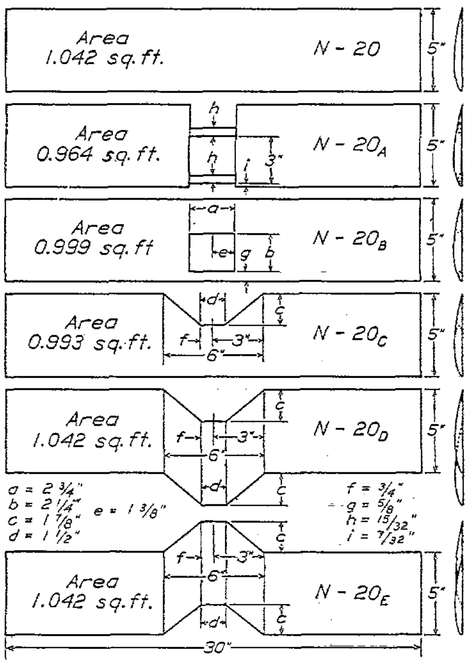

FIG. 1.—Principal dimensions of models

CAMBERS OF N-20 AIRFOIL

From L. E.	0	0.0125	0.0250	0.0500
Upper	.0107	.0300	.0390	.0510
Lower	.0107	0	0	0
From L. E.	.0750	.1000	.1500	.2000
Upper	.0590	.0650	.0732	.0770
Lower	0	0	0	0
From L. E.	.3000	.4000	.5000	.6000
Upper	.0817	.0806	.0761	.0694
Lower	0	0	0	0
From L. E. 0.7000	.8000	.9000	.9500	1.0000
Upper 0.0593	.0451	.0271	.0160	.0025
Lower 0	0	0	0	.0025

All dimensions given as decimal parts of chord length. Rad. L. E.=0.0107. Rad. T. E.=0.0025.

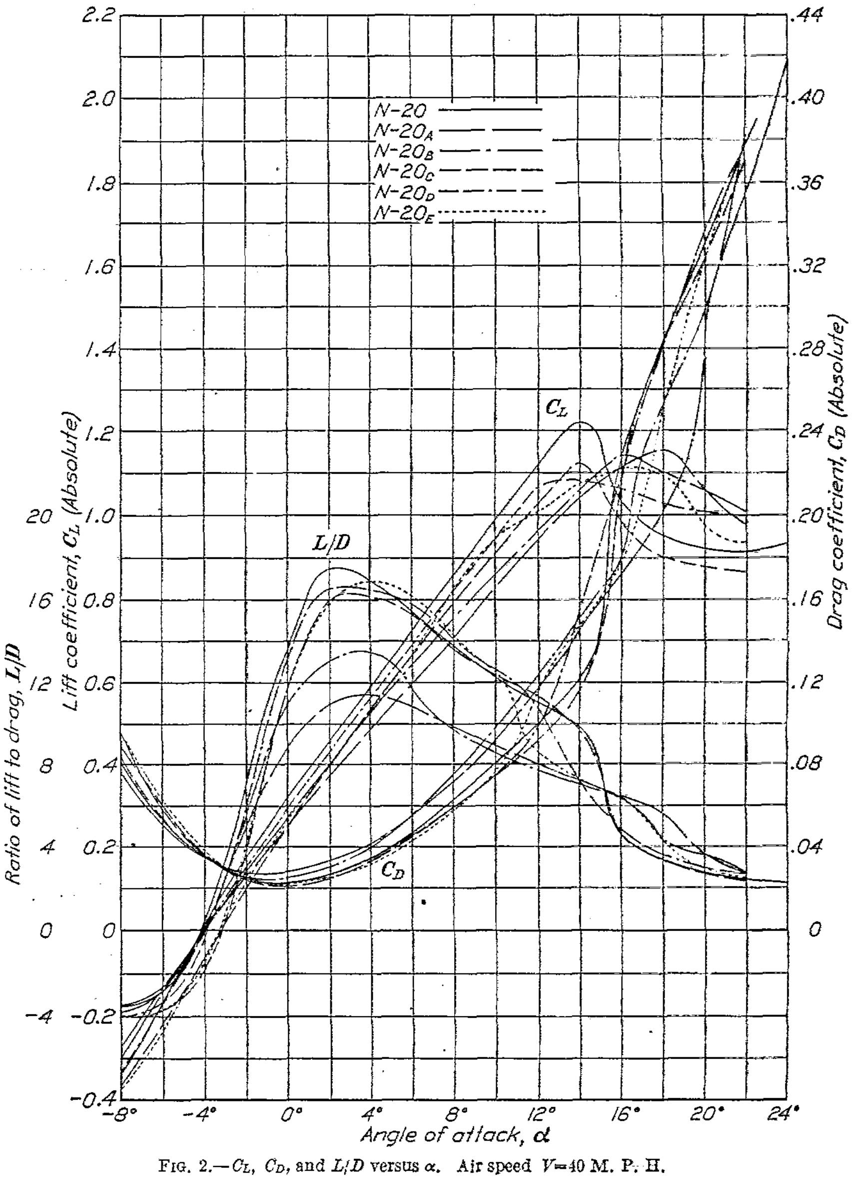

FIG. 2.—C_L, C_D, and L/D versus α. Air speed V=40 M. P. H.

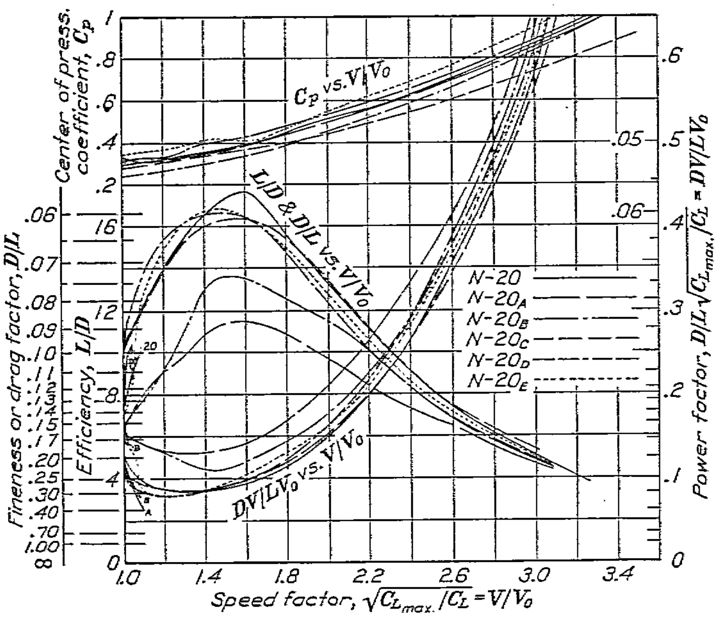

FIG. 3.—Functions of speed factor

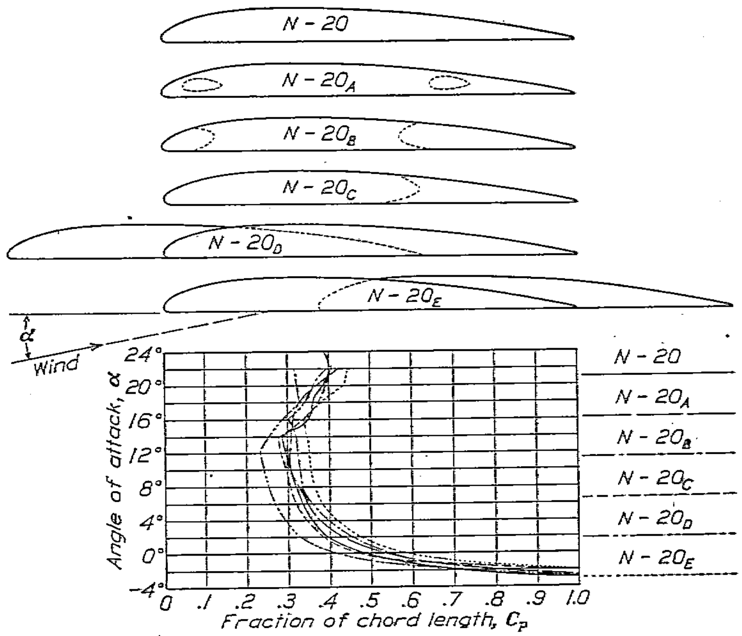

FIG. 4.—Sections and α versus C_p at V=40 M. P. H.

TABLE I

NET MEASURED LIFT, IN POUNDS, AT 40 M. P. H.

Angle of attack (degrees) α	N-20	N-20A	N-20B	N-20C	N-20D	N-20E
−8	−1. 440	−1. 067	−1. 242	−1. 485	−1. 388	−1. 560
−6	−. 716	−. 548	−. 612	−. 935	−. 750	−. 987
−5	−. 318	−. 273	−. 297	−. 598	−. 382	−. 609
−4	+. 067	+. 005	+. 015	−. 267	−. 027	−. 230
−3	. 415	. 291	. 310	+. 065	+. 323	+. 139
−2	. 740	. 547	. 585	. 383	. 607	. 494
−1	1. 047	. 783	. 850	. 695	. 962	. 812
0	1. 343	1. 011	1. 130	. 999	1. 259	1. 124
+2	1. 947	1. 440	1. 605	1. 602	1. 835	1. 687
4	2. 527	1. 872	2. 249	2. 217	2. 418	2. 270
6	3. 077	2. 371	2. 662	2. 750	2. 987	2. 847
8	3. 651	2. 816	3. 082	3. 255	3. 502	3. 488
10	4. 201	3. 283	3. 516	3. 755	4. 031	4. 028
12	4. 678	3. 740	3. 963	4. 212	4. 538	4. 279
14	5. 118	4. 150	4. 384	4. 625	4. 601	4. 583
16	4. 379	4. 435	4. 740	4. 037	4. 523	4. 824
18	4. 038	4. 610	4. 536	3. 703	4. 372	4. 665
20	3. 919	4. 239	4. 410	3. 611	4. 272	4. 141
22	3. 868	+3. 902	+4. 170	+3. 561	+4. 229	+3. 975
+24	+3. 957					

TABLE II

NET MEASURED DRAG IN POUNDS AT 40 M. P. H.

Angle of attack (degrees) α	N-20	N-20$_A$	N-20$_B$	N-20$_C$	N-20$_D$	N-20$_E$
−8	0.401	0.297	0.325	0.363	0.346	0.396
−6	.243	.203	.217	.247	.222	.260
−5	.191	.163	.173	.186	.170	.209
−4	.155	.136	.142	.149	.140	.160
−3	.123	.116	.121	.114	.115	.127
−2	.104	.109	.106	.100	.099	.109
−1	.096	.109	.098	.088	.095	.099
0	.098	.115	.102	.086	.095	.095
+2	.111	.132	.124	.100	.111	.107
4	.150	.164	.167	.138	.147	.135
6	.201	.220	.230	.179	.189	.176
8	.266	.287	.312	.241	.250	.244
10	.343	.368	.412	.305	.319	.323
12	.425	.466	.511	.373	.414	.503
14	.515	.576	.627	.473	.657	.625
16	.966	.685	.743	.902	.928	.755
18	1.210	.802	1.052	1.165	1.198	1.064
20	1.415	1.170	1.240	1.338	1.432	1.406
22	1.610	1.422	1.579	1.528	1.598	1.602
+24	1.780	----------	----------	----------	----------	----------

TABLE III

NET MEASURED PITCHING MOMENT ABOUT *M* AXIS* OF MODEL HOLDER IN POUND-INCHES AT 40 M. P. H.

Angle of attack (degrees) α	N-20	N-20$_A$	N-20$_B$	N-20$_C$	N-20$_D$	N-20$_E$
−8	+0.289	+0.202	+0.240	+0.342	+1.073	−1.677
−6	−.246	−.046	−.083	−.117	+.331	−1.360
−5	−.256	−.117	−.162	−.180	+.033	−1.038
−4	−.229	−.164	−.199	−.188	−.233	−.744
−3	−.190	−.232	−.243	−.157	−.516	−.182
−2	−.167	−.235	−.305	−.107	−.659	+.274
−1	−.145	−.200	−.334	−.039	−.693	.729
0	−.148	−.158	−.318	−.035	−.804	1.153
+2	−.199	−.243	−.433	−.176	−1.208	1.787
4	−.466	−.398	−.719	−.523	−2.021	2.207
6	−1.062	−.807	−.903	−1.064	−2.903	2.434
8	−1.913	−1.375	−1.292	−1.853	−4.086	2.393
10	−2.873	−2.182	−1.918	−2.860	−5.448	2.083
12	−4.096	−3.080	−2.852	−4.048	−6.888	2.261
14	−5.387	−4.265	−3.974	−5.277	−6.852	1.914
16	−2.982	−5.335	−4.948	−2.609	−6.428	1.491
18	−1.481	−6.536	−3.976	−1.573	−6.029	2.152
20	−1.205	−4.805	−4.260	−1.339	−4.936	3.416
22	−.868	−4.043	−2.483	−1.058	−5.038	+3.915
+24	−.920	----------	----------	----------	----------	----------

**M* axis, N-20, is 32.6 per cent of chord length aft of L. E. and 183 per cent of chord length below the chord.
M axis, N-20$_A$, is 29.8 per cent of chord length aft of L. E. and 180.4 per cent of chord length below the chord.
M axis, N-20$_B$, is 26.1 per cent of chord length aft of L. E. and 180.8 per cent of chord length below the chord.
M axis, N-20$_C$, is 25.6 per cent of chord length aft of L. E. and 183.4 per cent of chord length below the chord.
M axis, N-20$_D$, is 14.2 per cent of chord length aft of L. E. and 183.4 per cent of chord length below the chord.
M axis, N-20$_E$, is 62.8 per cent of chord length aft of L. E. and 183.8 per cent of chord length below the chord.

TABLE IV

LIFT COEFFICIENTS AT 40 M. P. H.

Angle of attack (degrees) α	C_L (absolute)					
	N–20	N–20$_A$	N–20$_B$	N–20$_C$	N–20$_D$	N–20$_E$
−8	−0.3388	−0.2674	−0.3003	−0.3613	−0.3266	−0.3671
−6	−.1685	−.1373	−.1480	−.2275	−.1765	−.2322
−5	−.0748	−.0684	−.0718	−.1455	−.0899	−.1433
−4	+.0158	+.0012	+.0036	−.0650	−.0635	−.0541
−3	.0976	.0729	.0750	+.0158	+.0760	+.0327
−2	.1741	.1371	.1415	.0932	.1428	.1162
−1	.2464	.1962	.2055	.1691	.2264	.1911
0	.3160	.2534	.2732	.2430	.2962	.2645
+2	.4581	.3609	.3881	.3897	.4318	.3970
4	.5946	.4691	.5438	.5394	.5690	.5341
6	.7240	.5942	.6437	.6690	.7028	.6699
8	.8591	.7057	.7453	.7919	.8240	.8207
10	.9885	.8227	.8502	.9135	.9485	.9478
12	1.1007	.9372	.9583	1.0247	1.0678	1.0068
14	1.2043	1.0400	1.0601	1.1252	1.0826	1.0784
16	1.0304	1.1114	1.1462	.9821	1.0643	1.1351
18	.9501	1.1553	1.0969	.9009	1.0287	1.0977
20	.9221	1.0623	1.0664	.8785	1.0052	.9744
22	.9101	+.9778	+1.0083	+.8663	+.9951	+.9353
+24	+.9311					

TABLE V

LIFT COEFFICIENTS AT 40 M. P. H.

Angle of attack (degrees) α	K_y (lb./ft.^{2}/mi.^{2}/hr.^{2})					
	N–20	N–20$_A$	N–20$_B$	N–20$_C$	N–20$_D$	N–20$_E$
−8	−0.000864	−0.000682	−0.000766	−0.000921	−0.000833	−0.000930
−6	−.000430	−.000350	−.000377	−.000580	−.000450	−.000592
−5	−.000101	−.000174	−.000183	−.000371	−.000229	−.000365
−4	+.000402	+.000031	+.000009	−.000166	−.000162	−.000138
−3	.000249	.000186	.000191	+.000040	+.000194	−.000083
−2	.000444	.000350	.000361	.000024	.000364	−.000030
−1	.000628	.000500	.000524	.000043	.000577	+.000487
0	.000806	.000646	.000697	.000062	.000755	.000674
+2	.001168	.000920	.000990	.000099	.001101	.001012
4	.001516	.001196	.001387	.000138	.001451	.001362
6	.001846	.001515	.001641	.000170	.001792	.001708
8	.002191	.001800	.001900	.000202	.002101	.002093
10	.002521	.002098	.002168	.000232	.002419	.002417
12	.002807	.002390	.002444	.000261	.002722	.002567
14	.003071	.002652	.002703	.000287	.002761	.002750
16	.002628	.002834	.002923	.000250	.002714	.002894
18	.002423	.002946	.002797	.000230	.002623	.002799
20	.002351	.002709	.002719	.000224	.002563	.002485
22	.002323	+.002493	+.002571	+.000221	+.002534	+.002385
+24	+.002374					

TABLE VI

DRAG COEFFICIENTS AT 40 M. P. H.

Angle of attack (degrees) α	C_D (absolute)					
	N–20	N–20$_A$	N–20$_B$	N–20$_C$	N–20$_D$	N–20$_E$
−8	0.0944	0.0744	0.0786	0.0883	0.0814	0.0932
−6	.0572	.0509	.0525	.0601	.0522	.0612
−5	.0449	.0408	.0418	.0452	.0400	.0492
−4	.0365	.0341	.0343	.0362	.0329	.0378
−3	.0289	.0291	.0293	.0277	.0270	.0299
−2	.0245	.0273	.0256	.0243	.0233	.0256
−1	.0226	.0273	.0237	.0214	.0224	.0233
0	.0230	.0288	.0247	.0209	.0224	.0224
+2	.0261	.0331	.0300	.0243	.0261	.0252
4	.0353	.0411	.0404	.0336	.0346	.0318
6	.0472	.0551	.0556	.0435	.0445	.0414
8	.0626	.0719	.0754	.0586	.0588	.0574
10	.0807	.0922	.0996	.0742	.0751	.0760
12	.1000	.1168	.1236	.0907	.0974	.1184
14	.1212	.1443	.1516	.1151	.1546	.1471
16	.2273	.1717	.1797	.2194	.2184	.1776
18	.2847	.2010	.2544	.2834	.2819	.2504
20	.3329	.2932	.2999	.3255	.3369	.3308
22	.3788	.3564	.3818	.3717	.3760	.3770
+24	.4188	----------	----------	----------	----------	----------

TABLE VII

DRAG COEFFICIENTS AT 40 M. P. H.

Angle of attack (degrees) α	K_X (lb./ft.^{2}/mi.^{2}/hr.^{2})					
	N–20	N–20$_A$	N–20$_B$	N–20$_C$	N–20$_D$	N–20$_E$
−8	0.0002407	0.0001894	0.0002004	0.0002252	0.0002076	0.0002377
−6	.0001459	.0001298	.0001339	.0001532	.0001331	.0001561
−5	.0001145	.0001040	.0001069	.0001153	.0001020	.0001255
−4	.0000931	.0000870	.0000875	.0000923	.0000839	.0000959
−3	.0000737	.0000742	.0000747	.0000706	.0000688	.0000762
−2	.0000625	.0000696	.0000653	.0000620	.0000594	.0000653
−1	.0000576	.0000696	.0000604	.0000546	.0000571	.0000594
0	.0000587	.0000734	.0000630	.0000533	.0000571	.0000571
+2	.0000666	.0000844	.0000765	.0000620	.0000666	.0000643
4	.0000900	.0001048	.0001030	.[illegible]	.0000882	.0000811
6	.0001204	.0001405	.0001418	.[illegible]	.0001135	.0001056
8	.0001596	.0001833	.0001923	.0001494	.0001499	.0001464
10	.0002058	.0002351	.0002539	.0001892	.0001915	.0001938
12	.0002550	.0002978	.0003151	.0002313	.0002484	.0003019
14	.0003091	.0003680	.0003866	.0002935	.0003942	.0003751
16	.0005796	.0004378	.0004582	.0005595	.0005569	.0004529
18	.0007260	.0005126	.0006487	.0007227	.0007188	.0006385
20	.0008489	.0007477	.00076[illegible]	.0008300	.0008591	.0008435
22	.0009659	.0009088	.0009737	.0009478	.0009588	.0009614
+24	.0010679	----------	----------	----------	----------	----------

TABLE VIII

SPEED FACTOR, POWER FACTOR, EFFICIENCY, AND CENTER OF PRESSURE COEFFICIENT AT 40 M. P. H. FOR N-20 WING

Angle of attack (degrees) α	Efficiency L/D	Speed factor $\sqrt{C_L\max/C_L}$	Power factor $\frac{D}{L}\sqrt{C_L\max/C_L}$	Center of pressure coefficient C_p
−8	−3.59	------------	------------	0.132
−6	−2.94	------------	------------	------------
−5	−1.66	------------	------------	------------
−4	+.43	8.751	20.335	------------
−3	3.37	3.521	1.049	1.098
−2	7.11	2.636	.371	.706
−1	10.91	2.214	.203	.564
0	13.71	1.957	.143	.494
+2	17.54	1.625	.093	.392
4	16.85	1.427	.085	.354
6	15.31	1.293	.084	.334
8	13.72	1.187	.087	.320
10	12.24	1.101	.110	.302
12	11.01	1.048	.095	.294
14	9.93	1.003	.101	.284
16	4.53	1.084	.239	.350
18	3.34	1.128	.338	.358
20	2.77	1.146	.414	.388
22	2.40	1.159	.483	.400
+24	+2.22	1.140	.514	.386

TABLE IX

SPEED FACTOR, POWER FACTOR, EFFICIENCY, AND CENTER OF PRESSURE COEFFICIENT AT 40 M. P. H. FOR $N\text{-}20_A$ WING

Angle of attack (degrees) α	Efficiency L/D	Speed factor $\sqrt{C_L\max/C_L}$	Power factor $\frac{D}{L}\sqrt{C_L\max/C_L}$	Center of pressure coefficient C_p
−8	−3.60	------------	------------	0.098
−6	−2.70	------------	------------	------------
−5	−1.67	------------	------------	------------
−4	+.04	8.978	224.200	------------
−3	2.51	3.992	1.590	1.291
−2	5.02	2.909	.580	.810
−1	7.19	2.431	.338	.634
0	8.80	2.141	.243	.534
+2	10.91	1.793	.165	.434
4	11.41	1.573	.138	.372
6	10.78	1.398	.130	.346
8	9.82	1.282	.131	.326
10	8.93	1.187	.133	.306
12	8.03	1.113	.139	.306
14	7.21	1.057	.137	.308
16	6.47	1.022	.158	.310
18	5.75	1.002	.174	.326
20	3.62	1.044	.288	.372
+22	+2.75	1.089	.396	.426

TABLE X

SPEED FACTOR, POWER FACTOR, EFFICIENCY, AND CENTER OF PRESSURE COEFFICIENT AT 40 M. P. H. FOR N-20_B WING

Angle of attack (degrees) α	Efficiency L/D	Speed factor $\sqrt{C_L\max/C_L}$	Power factor $\frac{D}{L}\sqrt{C_L\max/C_L}$	Center of pressure coefficient C_p
−8	−3.83	----------	----------	0.150
−6	−2.82	----------	----------	----------
−5	−1.72	----------	----------	----------
−4	+.11	17.873	178.680	----------
−3	2.56	3.927	1.530	1.297
−2	5.52	2.851	.516	.822
−1	8.67	2.366	.273	.640
0	11.08	2.053	.185	.542
+2	12.94	1.722	.133	.456
4	13.47	1.454	.108	.394
6	11.57	1.337	.116	.360
8	9.89	1.244	.126	.332
10	8.53	1.164	.136	.328
12	7.76	1.096	.141	.322
14	7.00	1.042	.149	.318
16	6.38	1.002	.157	.301
18	4.31	1.024	.238	.342
20	3.56	1.039	.292	.362
+22	+2.64	1.063	.404	.394

TABLE XI

SPEED FACTOR, POWER FACTOR, EFFICIENCY, AND CENTER OF PRESSURE COEFFICIENT AT 40 M. P. H. FOR N-20_C WING

Angle of attack (degrees) α	Efficiency L/D	Speed factor $\sqrt{C_L\max/C_L}$	Power factor $\frac{D}{L}\sqrt{C_L\max/C_L}$	Center of pressure coefficient C_p
−8	−4.09	----------	----------	0.174
−6	−3.78	----------	----------	.000
−5	−3.22	----------	----------	----------
−4	−1.79	----------	----------	----------
−3	+.57	8.471	14.856	----------
−2	3.83	3.483	.910	.918
−1	7.90	2.568	.325	.588
0	11.62	2.155	.186	.474
+2	16.02	1.704	.106	.384
4	16.06	1.448	.090	.346
6	15.36	1.300	.085	.316
8	13.51	1.195	.088	.306
10	12.31	1.125	.091	.294
12	11.29	1.065	.094	.282
14	9.78	1.002	.102	.280
16	4.48	1.072	.239	.334
18	3.18	1.121	.353	.374
20	2.70	1.134	.420	.392
+22	+2.33	1.143	.491	.406

TABLE XII

SPEED FACTOR, POWER FACTOR, EFFICIENCY, AND CENTER OF PRESSURE COEFFICIENT AT 40 M. P. H. FOR N–20_D WING

Angle of attack (degrees) α	Efficiency L/D	Speed factor $\sqrt{C_L \max/C_L}$	Power factor $\frac{D}{L}\sqrt{C_L \max/C_L}$	Center of pressure coefficient C_p
−8	−4.01	----------	----------	0.104
−6	−3.38	----------	----------	----------
−5	−2.25	----------	----------	----------
−4	−.19	----------	----------	----------
−3	+2.81	3.778	1.344	1.223
−2	6.13	2.764	.452	.728
−1	10.13	2.194	.217	.504
0	13.25	1.913	.144	.412
+2	16.53	1.587	.096	.322
4	16.45	1.384	.084	.292
6	15.80	1.246	.079	.264
8	14.01	1.151	.082	.252
10	12.64	1.072	.085	.242
12	10.96	1.011	.085	.232
14	7.02	1.004	.143	.252
16	4.88	1.013	.208	.284
18	3.65	1.030	.282	.328
20	2.98	1.042	.350	.322
22	+2.64	1.050	.398	.316

TABLE XIII

SPEED FACTOR, POWER FACTOR, EFFICIENCY, AND CENTER OF PRESSURE COEFFICIENT AT 40 M. P. H. FOR N–20_E WING

Angle of attack (degrees) α	Efficiency L/D	Speed factor $\sqrt{C_L \max/C_L}$	Power factor $\frac{D}{L}\sqrt{C_L \max/C_L}$	Center of pressure coefficient C_p
−8	−3.94	----------	----------	0.216
−6	−3.80	----------	----------	.080
−5	−2.91	----------	----------	----------
−4	−1.44	----------	----------	----------
−3	+1.09	5.909	5.421	----------
−2	4.53	3.118	.688	1.000
−1	8.20	2.443	.298	.704
0	11.83	2.077	.176	.578
+2	15.77	1.695	.107	.410
4	16.81	1.462	.087	.416
6	16.18	1.305	.081	.380
8	14.30	1.178	.082	.364
10	12.47	1.098	.088	.352
12	8.51	1.065	.125	.352
14	7.33	1.028	.140	.344
16	6.40	1.002	.157	.338
18	4.38	1.019	.235	.376
20	2.94	1.082	.368	.438
22	+2.48	1.080	.436	.446

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TABLE XIV

DATA AND CHARACTERISTICS

Data and characteristics	N-20	$N-20_A$	$N-20_B$	$N-20_C$	$N-20_D$	$N-20_E$	Significance for airplanes of same weight and propulsive system
SPECIFICATIONS							
Source of design	(1)	(1)	(1)	(1)	(1)	(1)	
General shape	(2)	(2)	(2)	(2)	(2)	(2)	
Per cent chord length:							
Maximum top camber.	8.17	8.17	8.17	8.17	8.17	8.17	
Thickness 10 per cent from nose.	6.50	6.50	6.50	6.50	6.50	6.50	Front spar depth.
Thickness 15 per cent from nose.	7.32	7.32	7.32	7.32	7.32	7.32	
Thickness 60 per cent from nose.	6.94	6.94	6.94	6.94	6.94	6.94	Rear spar depth.
Thickness 70 per cent from nose.	5.93	5.93	5.93	5.93	5.93	5.93	
Maximum thickness	8.17	8.17	8.17	8.17	8.17	8.17	
DIRECT WIND TUNNEL DATA							
Size of tunnel	(3)	(3)	(3)	(3)	(3)	(3)	
Speed V of test ft./sec	58.67	58.67	58.67	58.67	58.67	58.67	
V of test, ft.²/sec	24.44	24.44	24.44	24.44	24.44	24.44	
No lift angle α	−4.2°	−4.0°	−3.9°	−3.2°	−3.8°	−3.4°	
Main slope of C_L curve	.069	.057	.052	.075	.069	.066	
C_L maximum	1.209	1.158	1.150	1.125	1.089	1.135	Minimum speed.
C_L at maximum L/D	.482	.471	.540	.451	.478	.540	
C_D minimum	.023	.027	.024	.021	.022	.022	
Range of C_p for $2V_o<V<3V_o$ in per cent chord length.	.356	.347	.360	.301	.387	.402	
COMPUTED RATIOS							
L/D maximum	17.69	11.41	13.47	16.40	16.72	16.81	Minimum wing drag; maximum speed regardless of minimum; flattest glide; maximum radius; maximum lb.-miles/lb. fuel.
L/D at 1/3 C_L maximum	5.8	4.4	4.6	6.2	5.8	6.0	Effectiveness for speed.
L/D at 2/3 C_L maximum	14.3	12.8	10.2	14.8	15.4	15.0	Effectiveness for climb.
(C^3_L/C^2_D) maximum	171.0	69.6	98.3	158.2	118.0	175.4	Minimum power; maximum rate of climb; maximum absolute ceiling; maximum duration. (All with constant loading.)
C_L maximum/C_D minimum.	52.6	42.9	47.9	53.6	49.5	51.6	Maximum speed with given minimum.
C^3_L maximum/C^2_D minimum.	3,340	2,130	2,644	3,228	2,665	3,016	Maximum speed ratio V/V_o.

[1] Navy Department. [2] See fig. 1. [3] 8 by 8 feet.